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POWER AND GAS
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VOLUME XXV SAN FRANCISCO, NOVEMBER 12, 1910. NUMBER 20

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THE GREAT POWER PLANT AT ELECTRA

BY ARCHIE RICE.

Archie Rice

In California snow is converted into electric light. The dazzling white mantle upon her lofty mountain tops flashes forth again by the sea. California sunshine sips vapor from the heaving bosom of the Pacific. The trade winds carry the saturated atmosphere inland. Heated air rising from the great interior valleys buoys up the vapory masses as they pass way overhead. They float gently on till they are checked by the towering ramparts of the mighty divide that walls California all along her eastern boundary. Hovering there the clouds wait till a fall in the temperature relieves them of their burden. To the deep, white masses upon the Sierra crests those clouds then add their myriad of little icy crystals.

Again California sunshine brings a change. The rainy season is over. Drying valleys are athirst. Steep mountain-slope streams are dwindling. And then that jagged white skyline begins to melt and renew the springs.

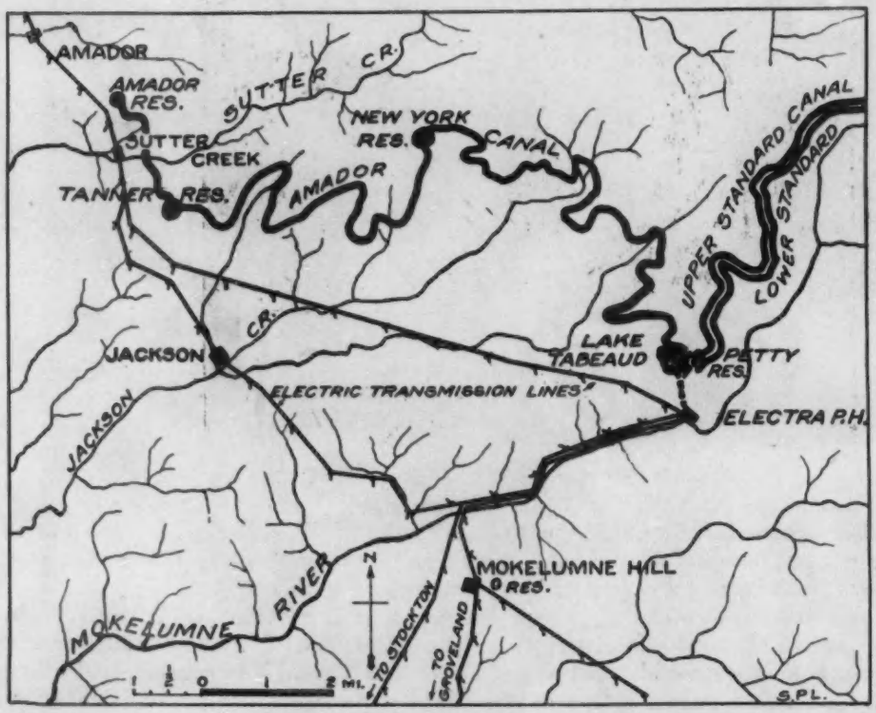
The gleam in that mountain-top snow, ten thousand feet in the air, starts on its way to be transformed into the glow of artificial light. After a downward journey of more than two hundred miles it appears again, spangling the darkness about San Francisco Bay with tens of thousands of lights, picking out the cities in detail and making them sparkle in the night like a fairyland strewn with brilliants.

In the Power House at Electra.

You get the wonderful effect of it when gazing down from the summit of Mount Tamalpais, 2600 feet above the Golden Gate. The accumulated energy that makes these city lights has come from snowy summits four times as high as Tamalpais.

No other hydroelectric system in the world more

Showing the Location of the Company's Alta, Auburn, Newcastle, Folsom and Electra Power Plants and Their Water Sources and Canals.



Map Showing the Immediate Surroundings of the Electra Power Plant.

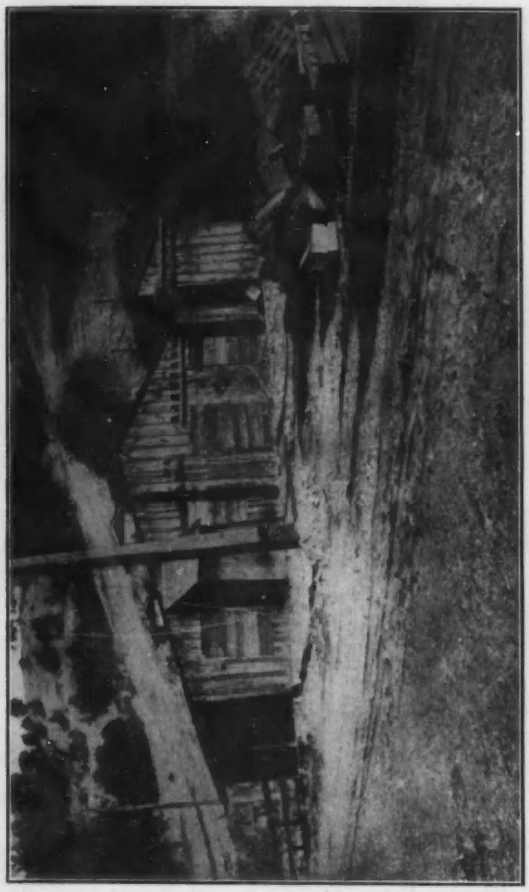
graphically demonstrates the various stages of this mysterious evolution of a snowball into an incandescent light than does the giant generating plant at Electra. It is on the Mokelumne River in Amador County, near the middle of the eastern part of California, a dozen miles from the old mining town of Jackson.

A little to the southward of Take Tahoe is Alpine County. It is so sparsely peopled that, all told, its inhabitants would form a village of only a few hundred people, and mostly Indians at that.

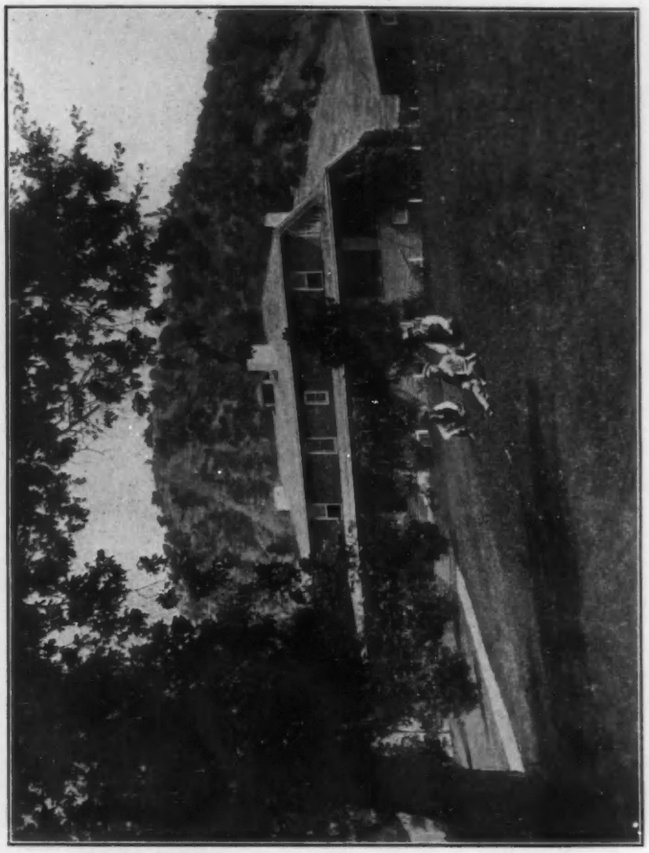
Alpine County is rightly named. Its back is bumped and its sides slope east and west from the divide. Terraced high along its western slopes are natural basins filled with snow-water.

That is the country of the Blue Lakes. And the Blue Lakes are part of the high mountain, storage system that supplies the Electra power plant. There are four lakes in that group. They cover an area of from one hundred and twenty to three hundred and forty acres each. They range in depth from twenty to sixty feet and in elevation above the sea-level from 5700 to nearly 8200 feet. They store water for the day of need.

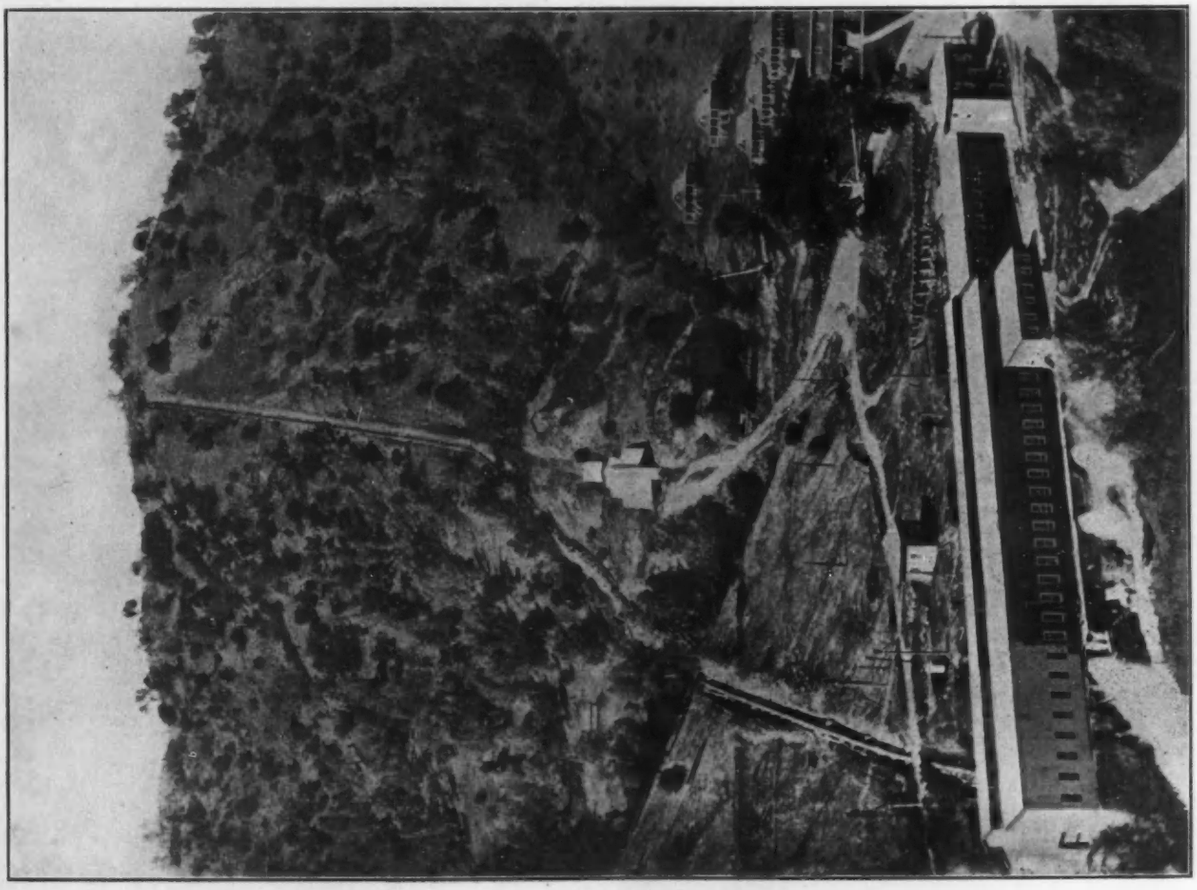
Men stationed at the lakes regulate the outflow into the Mokelumne River according to telephonic directions given them each day by the superintendent at the power plant. He calls for whatever water-flow he needs, and he gets it. The lakes are eighty miles from the power plant. The river for some fifty miles serves as a channel outlet for the lakes. Then ditches and canals tap the river and skirt the mountain ridges and bring the lake water gradually along for twenty miles to the place where it is finally shot down through



The Original Electra Power Plant.



The Clubhouse, Known as the Standard Hotel, with John A. Britton and Friends on the Lawn.



General View of the Electra Power Plant on the Mokelumne River in Amador County, California, where 28,100 Electrical Horsepower Is Generated.

big steel pipes to drive the impulse wheels at Electra. In those twenty miles the river drops about sixteen hundred feet. But the man-made canal uses a very gentle gradient. When the canal water finally reaches the forebay reservoir on a ridge overlooking the river, it is then more than 1450feet higher than the river water flowing past the power house that stands down below on the bank of the Mokelumne. In falling from that height the diverted water produces unbelievable energy, tremendous power. It flows down through the pipes at a steep angle. The height of the fall produces an amazing hydraulic force. From the four-inch nozzles under the power house the liberated jets flare big and shoot two hundred yards out into space, driving furiously at a speed of three and four-tenths miles a minute.

They have torn up the rock-ribbed river-bed as the stream from a garden hose might gutter out soft loam. When they emerge from the building they are already swollen to the thickness of a man's body. They flare bigger as they slip through the air—rocketing, hissing, moaning, humming, thundering with a force that fascinates the spectator.

The lofty drop is the favorite California method of producing water-power. In the east they slightly divert a river to make a fall of a few feet, relying on a great volume of water to create the force. But the steep slope of the streams in the Sierras and the convenient chances for reserve storage permit the use of much less water and the creation of an artificial fall of many hundreds of feet to produce enormous power.

That battering force at Electra strikes into the steel water-wheel buckets like a hurricane into a windmill and revolves them faster than the eye can follow the movement. The ponderous shafts connected to these water-wheels turn the seven huge electric generators.

Thus the snowflake becomes the electric spark.

The collected energy stored up in these mountain lakes has come down with a final rush to the power plant and been suddenly converted into a continuous force of 28,100 horsepower. Can you imagine the horse equivalent of that power? that many animals pulling at some great load? Close-coupled and hitched two abreast, the team would stretch out nearly twenty-seven miles!

Produced at a potential of 2300 volts, that gigantic electric force is passed though eighteen transformers and its potential raised to 60,000 volts. And at that force it thrills silently and unseen through big copper wire, over hills and across streams, traversing valleys and spanning channels along a pole-line route that runs through Stockton and Mission San Jose, and then diverges with a branch up to Oakland, another round the Palo Alto side of the bay to San Francisco, and a third to the seacoast in San Cruz County, a maximum transmission distance of one hundred and forty miles.

Electra as a power plant was an evolution from a different purpose. Back in the year 1871 the Blue Lakes Water Company was formed to supply water to the gold mines in Amador county. A ditch system more than eighty miles in length was built to convey the lake water to where it could be sold to the miners. For nearly thirty years the enterprise was very profitable. Then hydraulic mining was forbidden by law because of the muddy debris that was choking up the navigable streams. And old producing quartz mines began to wane. The water company's business accordingly dwindled. There was lack of consumers.

Along in the nineties there came to California a tall, rather esthetic-looking young man who was welcomed in the highest society. He was the proud descendant of a royal Polish family that had maintained its titles despite the expatriating influence of Russia's grip on Poland.

Prince Andrea Poniatowski cared for other things than social functions. He had the business instinct of the promoter and a personality that could interest investors in his schemes.

He conceived the idea of buying up a lot of those old abandoned mines in Amador county and consolidating them under a single management that they might be worked for a profit. And while he was studying out the situation he hit upon another idea. Why not take water from that Blue Lakes Water Company's ditch and drop it down at a convenient point and use the fall for a hydroelectric plant?

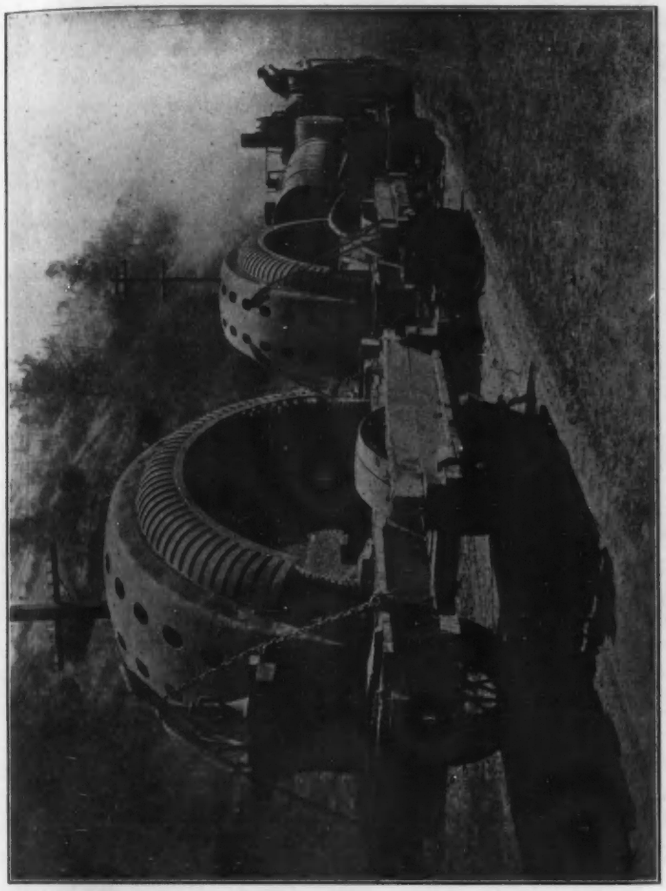
So he started the original Electra power house. It was located on the Mokelumne River about three miles downstream from the present plant. It got its water from a ditch flowing along the ridge at an elevation of about a thousand feet above the power house. It was his original intention to wire this electric energy to his mines and reduce the cost of their operation.

But before that little plant was completed Poniatowski had still another idea. Why not buy out the whole Blue Lakes Water Company in its condition of business decline and build a big power plant and transmit electric energy way down to San Francisco, a distance of one hundred and ten miles? There was no precedent at that time for any such long-distance transmission. His was a daring plan. But he interested investors, bought the water company, and formed the Standard Electric Company of California.

The best engineering skill in the whole country was sought for advice and plans. Nothing was adopted that was not feasible. Practical ideas were everywhere incorporated into the scheme. After the company's own engineers has figured out the possibilities and the costs the Stanley Electric Manufacturing Company of Pittsfield, Massachusetts, proposed the then amazing plan of operating the power lines at 50,000 volts, and promised such a monetary saving that the contract was awarded to that company for the machinery.

So careful were the builders of the big plant in making sure that their ideas were feasible, that the energy could be transmitted more than one hundred miles when the arrangements should all be completed, that they took four years for the work. Every step was a certain one. So sure were they of successful accomplishment that they contracted to furnish certain power to certain prospective consumers on a certain date.

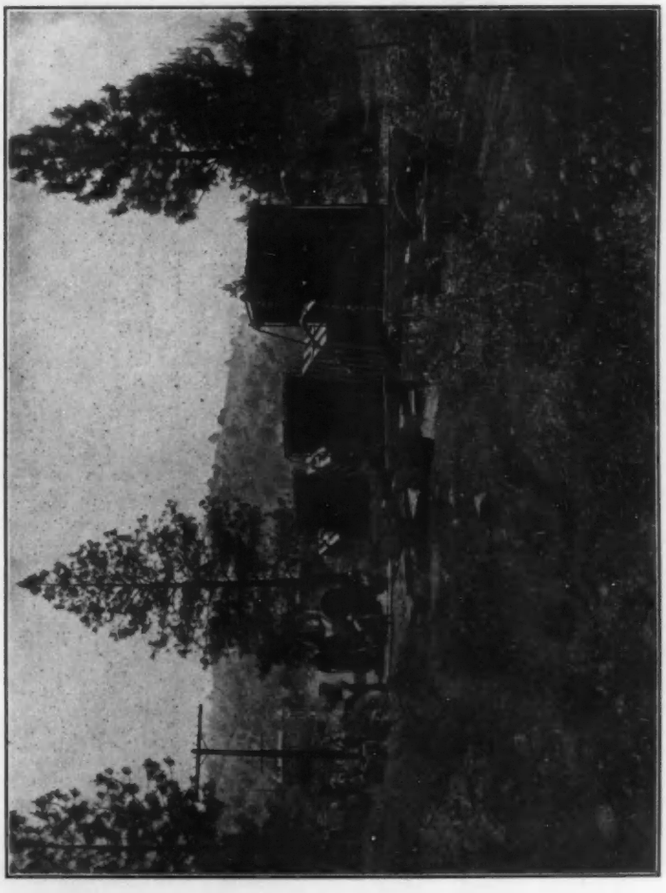
While the builders of Electra were taking time and infinite precautions to guard against failure the big Colgate power plant was started and built in a hurry



Traction Engine Hauling Armatures for the 5500-Kilowatt Generators.

The Shaft of One of the 5500-Kilowatt Generators Being Hauled Near the Electra Power House, With Horses and by Cable.

Swinging Sections of No. 3 Pipe-Line From a Ten-Mule Wagon Into Place With a Derrick.



A Traction Engine Hauling Three of the 1250-Kilowatt Transformers Between Jackson and the Electra Power Plant.

by John Martin and Eugene de Sabla. They mapped out a power-line headed for Oakland and did the amazing thing of spanning the Straits of Carquinez with aerial cables more than two hundred feet above the water and some 6000 feet long. Thus Colgate beat Electra to the honor of being the first California mountain power plant to send its energy down into the cities about the bay; achieved even a greater transmission distance than Poniatowski had planned for Electra.

At first the intention was to bring the Electra power lines down through Stockton to the bay, and then across to San Francisco on poles driven in the shallower water far to the southward of the ferry crossings. But the United States government would not consent to the planting of poles across the bay. So the line was led through the hills to Mission San Jose and forked there up both sides of the bay by land.

It was estimated that the storage capacity of the Blue Lakes and the associated reservoirs owned by the company in the high Sierras would keep the Electra plant running for a period of one hundred and fifty days if necessary. And that was time enough to carry it through the longest dry season ever known in California's history.

A great force of workmen was sent into the mountains to repair and enlarge the aqueducts and carve the way for the big plant. There were four construction camps with from one hundred to three hundred men in each. Those were great times in 1901 for the contractors! They exploited the workmen for their own gain. Each camp had its saloons and its gambling outfit. Men were paid in cash, and they were encouraged to spend freely at the camp. Those that did not patronize the bar were considered undesirables and eliminated. This sort of thing went on till J. Frank Pierce happened to go up into the mountains. He is a prominent Mason, well known throughout California. He was one of the officials of the Standard Company. He had the liquor at every camp dumped out. He made them throw away the crude kitchen ware. He installed a new order of things. He announced that men should have a chance up there in the mountains to save some of the money that they earned; that many purposely sought employment far from towns that they might avoid drink and save their earnings. And from that day on the contractors had to forego the exploitation of the workmen as a side profit.

Twenty miles upstream from the Electra power house there is a concrete dam across the Mokelumne River. There a flow of 5000 miner's inches is diverted into the Standard ditch, which is built along the mountain side to a point opposite the power house. This ditch empties into the petty reservoir, which is the forebay from which the three original pressure pipes carry water down to the plant, a pipe-line distance of about 3600 feet. This is the source of the high-head that operates the five original generators of 2000 kilowatts each.

The petty reservoir is a long, narrow gash partly behind the crest of the ridge and covering an area of about two or three acres to a depth of six or eight feet. From near the inlet end of this little reservoir a flume branches westward carrying the water to the mines in Amador City, Jackson, and Sutter Creek. Along that ditch system are three minor reservoirs holding 4.640,000 cubic feet to maintain the supply to the towns.

When the demand for electric energy grew beyond the original expectations of the California promoters of power plants Electra prepared to enlarge its generating capacity.

A second canal, called the Amador ditch, was built, taking water out of the river at a point about two miles below the first one. This canal practically parallels the course of the earlier aqueduct, winding along below it on the mountain side. With this additional flow it was intended to operate two new generators each of 5500 kilowatt capacity. These machines, really smaller and more compact than any one of the old ones generating only 2000 kilowatts, were installed in a comparatively small addition built onto the southern end of the power house.

The original machines were set diagonally across the power house floor to have them more nearly at right angles to the direction of the water flow in the pressure pipes. But when the two new generators were installed by Frank G. Baum they were placed square with the building and the end of the new pressure pipe was curved to produce a final right-angular strike of water into the buckets.

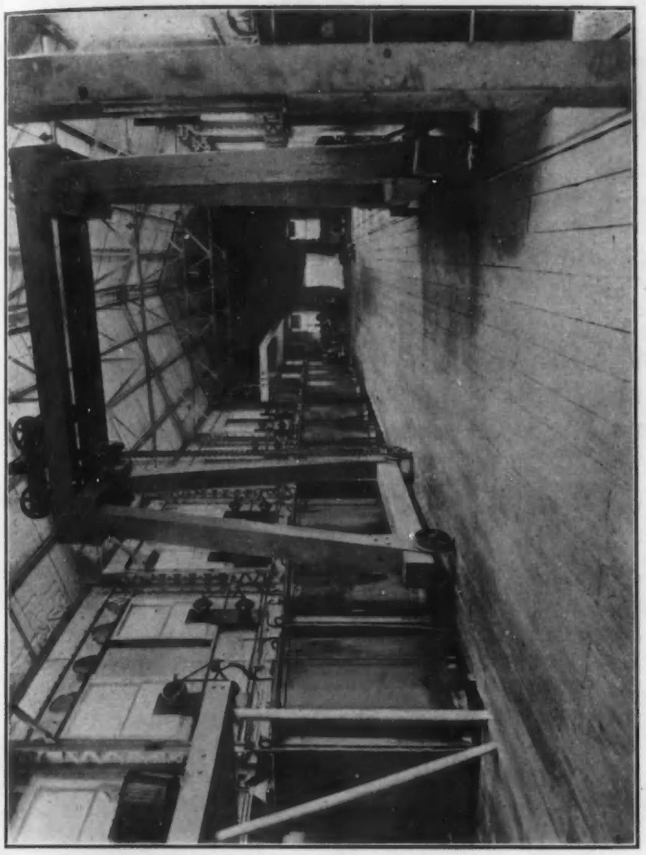
The lower canal produced a fall of about 1250 feet. But there was no way of checking the flow of water or conserving it when it was not needed on the wheels. Nor was there any space on the river side of the mountain where a small storage reservoir could be excavated to receive the surplus flow. There was no way of controlling the flow in either ditch along that twenty-mile route.

A novel engineering plan was then perfected. On the opposite side of the ridge, where descending lateral ridges left a wide ravine, a high earth-fill dam was built and a reservoir created that is known as Lake Tabeaud after the Tabeaud family that had owned the land. This lake has a surface area of about forty acres. It is fed by the excess flow spilling over from the petty reservoir two hundred feet above it and also by the excess flow from the lower canal. But the unique feature of the scheme is that a tunnel 3000 feet long had to be dug through the ridge to make an outlet. Through this long tunnel the water from Lake Tabeaud is drawn off into the low-head pressure pipe. At the outflow mouth of the tunnel there are gates in two of the descending high-head pressure system pipes. Thus water from Tabeaud dam may be turned into them in an emergency. But for the time they operate under the low-head pressure. By this arrangement all the generators in the power house may be run with water from Lake Tabeaud, which has a capacity sufficient to supply the plant for several days, in case of trouble on the ditches from the river.

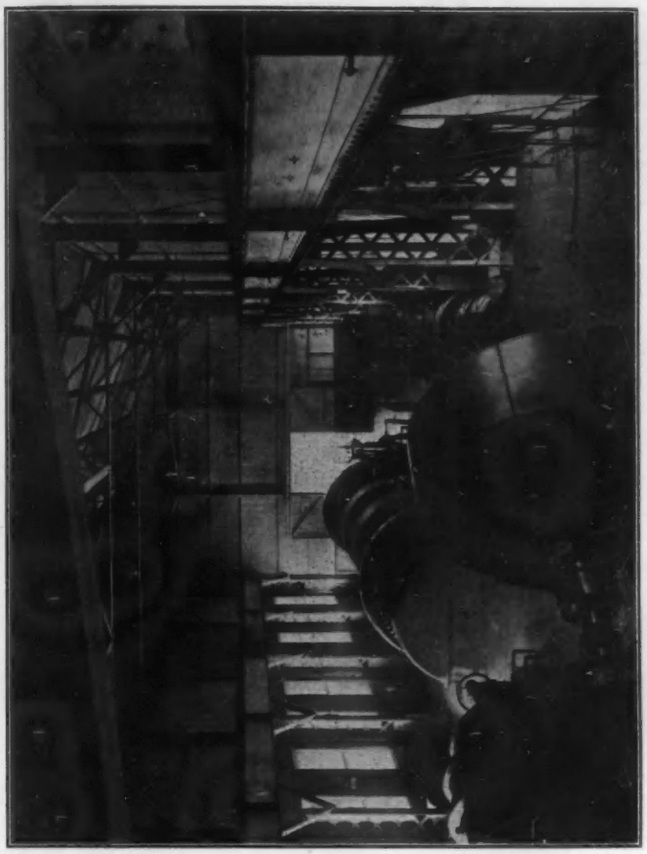
When the great consolidation of central California power plants was effected a few years ago the Standard Electric Company, with its allied water company, became a part of the Pacific Gas & Electric Company and the largest of its generating plants.

The illustrations that accompany this article leave little for verbal description. They tell their own story of the scenery and surroundings.

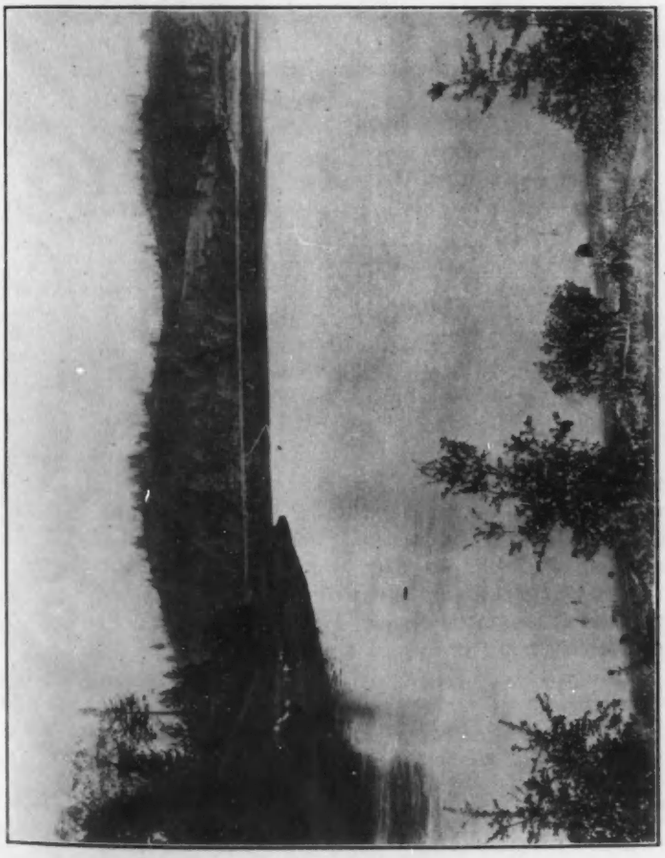
Only no picture correctly conveys an idea of the



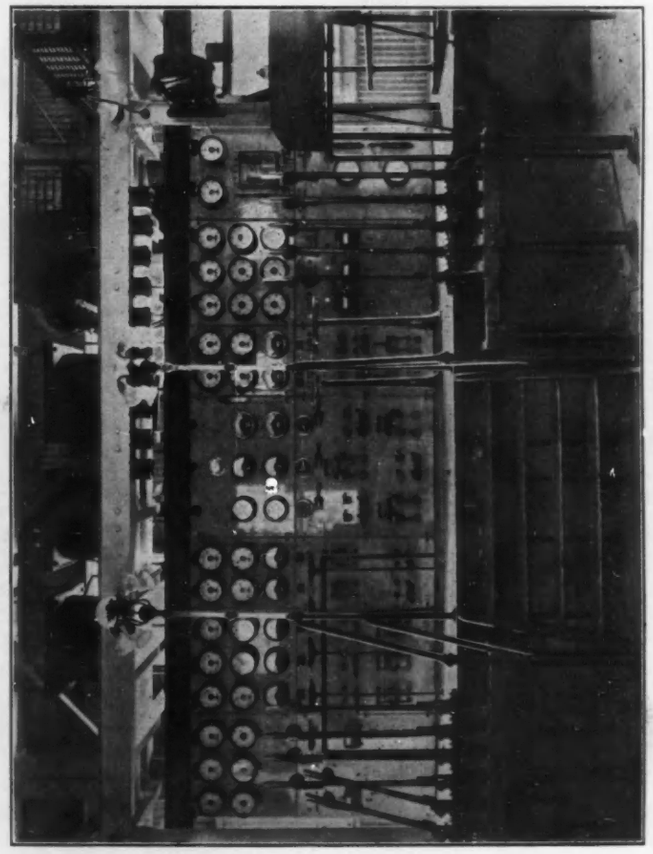
Showing the Transformers and the Machine Shop in the East End of the Power House.



The West End of the Electra Power House, Showing the Two 5500-Kilowatt Generators of the Later Installation and One of the Five (Diagonally Set) 2000-Kilowatt Generators of the Original Installation.



Lake Tabeaud, Over the Ridge Above Electra, Showing the High Earth-Fill Dam.



The Switchboard in the Electra Power House.

steepness of the little tramway. You perch on a toboggan-like car and are quiveringly pulled 2400 feet up to the top of the pressure pipe-lines, half the height of Tamalpais, in seven minutes.

Life at Electra is no miserable isolation. The environment is charming, the scenery inspiring; and ever, day and night, there is the unceasing hum of the generators converting that downrush of hidden waters into 28,100 electrical horsepower.

PHYSICAL DATA, ELECTRA POWER PLANT.

Capacity of storage reservoir .....1,079,902,616 cubic feet
Area of storage reservoirs ..... 949.3 acres

Lake.	Flooded Area- Elevation-ft.	Acres.	Depth-ft.	Capacity- Cu. ft.
Twin	8,172	118.3	20	62,063,850
Upper Blue	8,131	343.5	27.5	293,859,766
Lower Blue	8,040	145	35	162,000,000
Meadow	7,773.5	141.2	65.5	244,500,000
Bear River	5,680	161.6	57.5	267,054,000
Tabeaud	1,965	39.7	90	50,425,000
Totals		949.3		1,079,902,616

Length of main ditch and flume system ..... 36.75 miles
Flow the second in main ditch system .... 243 cubic feet

Elevation head
two pipes each ..... 1,467 feet
one pipe ..... 1,267 feet
Pressure of water the square in.
2 pipes each 636 pounds
1 pipe ..... 548 pounds
Speed of jets down at the power house..... 3.4 miles a minute
Number of impulse wheels 8
Capacity of generators.....5 of 2000 kw. each; 2 of 5500 kw. each
Total electrical horsepower 28,100
Generating voltage 2,300
Voltage on main line 60,000
Altitude of petty, or forebay, reservoir ..... 2,160 feet
Altitude at power house ..... 693 feet
Size of power house ..... 40 x 270 feet
Material of building .....
..Concrete foundations, steel frame, galvanized iron covering
Plant placed in service 1902

CHEMICAL CONTROL OF OIL GAS MANUFACTURE.[1]

BY E. L. HALL.

(Concluded.)

Miscellaneous Control.

For the purpose of checking up on the control for illuminating and calorific values, and for study of operating conditions, the daily gas analysis is invaluable.

The analysis should be made with a Hempel apparatus. It is fully as rapid as and much more accurate than most of the other different forms of gas analysis apparatus.

A slight modification of the usual burette enables the potash pipette to be permanently attached to one of the openings of the three-way stop cock, effecting a slight saving in time and decreasing the liability of introducing caustic potash into the burette.

There has been considerable controversy during the past few years as to the accuracy and proper manipulation of the nickel cyanide absorption method for benzene vapors. The method of Dennis and O'Neil is probably accurate under the conditions specified by them. The separate estimation of benzene is unavoidable where one desires to calculate the calorific values of the gas.

Fuming sulphuric acid should be used for the ethylene absorption.

The estimation of oxygen should be carried out by means of stick phosphorus.

An acid solution of cuprous chloride for carbon monoxide determination is preferable to an ammoniacal solution because of the liability of the latter to stopping up the capillaries of the pipette. By washing the cuprous chloride with a dilute solution of hydrochloric acid before making up, the same can readily be reduced to a water white solution by means of copper strips.

It is advisable to store a part of the residue from the carbon monoxide determination in the cuprous chloride pipette, and to duplicate the explosion for estimation of hydrogen and methane.

The following figures are in use in this laboratory for the calculation of calorific value. It is well to remember in this connection that heating values which are right at 0 degree F. are wrong at 60 degrees F.

Benzene	3807.4
Ethylene	1588.0
Carbon monoxide	323.5
Hydrogen	326.2
Methane	1009.0

There is no reason why calculated and observed values for caloric value of gas should show any great discrepancies, providing samples for gas analysis and calcrimeter tests are taken simultaneously.

The interpretation of the gas analysis may afford, in the hands of one thoroughly familiar with the manufacture, a very valuable means of operating control.

The presence of a high percentage of carbon dioxide and carbon monoxide is a sure indication of low heats caused by a foul machine or by an excessive water content of the crude oil. The percentage of oxygen should be closely watched in case a small percentage of air is being continuously admitted into the gas for purification purposes. A high percentage of hydrogen shows that the superheater heats are being carried too high.

Gas anaylses should be made occasionally of the blast products and it may be found that a great deal of combustible matter is being allowed to escape for lack of enough blast pressure.

The flue gases from the boilers may be analyzed in the same way for regulating the dampers and condition of the fires.

It is a matter of considerable importance to ascertain the amount of physical impurities remaining in the gas at different stages of the manufacturing process. These impurities, consisting of tar or a tarric pitch and a certain amount of lamp black, must be thoroughly removed by the water and shavings scrubbers before entering the purfiers.

The analysis is conveniently carried out as follows: A calcium chloride U tube is filled with cotton or mineral wool. It is placed in an air bath and connected to a source of suction. The temperature is maintained at 100 degrees C. A current of air is drawn through the apparatus until the tube attains a constant weight. The apparatus is now ready for the test. It is connected up by means of a piece of glass tubing and a rubber stopper as closely as possible to the main, and a sample of the gas is passed through the tube and then into a test meter for measuring the volume of the sample. It is advisable to take a large quantity of gas for the sample. The amount will depend upon the position in the works. More will be required at the inlet to the purifiers than at the inlet to the relief

holder. The tube is again placed in the air bath and dried in the same way to constant weight. The increase represents the physical impurities of the gas, which are reported in grains per 100 cu. ft.

Should it be desired to differentiate into the nature of the impurities, the cotton or mineral wool may be removed from the tube and extracted with alcohol. The loss represents tarry matters. The difference between the weight of the tarry matters and the total amount of the impurities is equivalent to lamp black.

The amount of cyanogen compounds present in the gas may be estimated by bubbling the latter through a series of wash bottles containing a mixture of caustic soda and copperas solution, by which the cyanogen is taken up. The solution is made acid with hydrochloric acid and it may be necessary to remove sulphur with barium chloride before precipitating the cyanogen with ferric chloride as Prussian blue, which is filtered off, washed till free from chlorides, dried, ignited and weighed as ferric oxide, from which the amount of cyanogen is calculated. The same is reported as hydrocyanic acid in grains per 100 cu. ft.

Control of Operating Conditions and Technical Report.

It is often the practice of medium sized works to include in the daily routine of the chemist, the collection of miscellaneous works data, consisting mainly in the observation of temperature and pressures around the works. No better method can be taken for rapidly initiating the young chemist into the operation of the works, without which knowledge the value of his work is greatly reduced. This practice is open to the objection of taking up a great deal of time from the regular laboratory work, but when thoroughly familiar with all the details of the manufacture through daily contact in this manner, the chemist becomes of a great deal of assistance to the foreman or superintendent. He may well be intrusted also with the preparation of the daily manufacturing report. The concentration in the hands of one man, of all the technical data connected with the operation, enables a better study of the same to be made and relieves the operating head of an enormous amount of work which is preliminary to improvements in operating methods.

Valuation of Raw Materials.

The valuation of raw materials in the laboratory may be the means effecting large economy in operation. The most important manufacturing material is, of course, crude oil.

Crude oil is usually examined for specific gravity, viscosity, sulphur contents and percentage of water and sand.

The Beaume scale is generally made use of for reporting specific gravity. It is very seldom necessary to use a more delicate method. In this connection the following corrections for temperature may be found useful. I am indebted to Mr. P. W. Prutzmann, who is generally recognized as an authority on the subject.

TEMPERATURE CORRECTION FOR BEAUME HYDROMETER

From 10°-20° Be. add or subtract .065 Be. per 1° Fah. under or above 60° Fah.

20°-35°	.070
35°-45°	.075
45°-55°	.080
55°-70°	.085

The viscosity of crude oil is really of nearly as much importance as the specific gravity for the reason that the pumping capacity of the plant depends a great deal upon this factor. The efficiency of the burners in the generators may also be affected by a change in the viscosity of the oil.

The percentage of sulphur in crude oil is a matter of the greatest importance. It is the duty of the chemist to subject the oil to examination for this impurity as soon as received in order that provision may be made to cope wth an unduly high percentage of hydrogen sulphide in the gas. The analysis is most conveniently carried out by exploding in a bomb about one gram of the oil thoroughly mixed up with about fifteen grams of sodium peroxide. The residue from the explosion is dissolved in water, made acid with hydrochloric acid, filtered free from lampblack and precipitated with barium chloride in the usual way. The amount of sodium peroxide to be used is gauged according to the appearance of the products of explosion. A residue of oil or the presence of much carbon in the bomb shows insufficient peroxide, while an excess may prevent a successful and complete combustion. The method is a modification of the Sundstrum method for the estimation of sulphur in coal and was written up for an early edition of the "Purifier," a defunct organ of this association, by Mr. P. W. Prutzmann.

The percentage of sulphur in the crude oil bears a definite relation to the percentage of hydrogen sulphide and organic sulphur in the raw gas. It may be stated roughly that every one per cent of sulphur in the oil will be responsible for from 250 to 300 grains of hydrogen sulphide and from 30 to 35 grains per 100 cu. ft. of organic sulphur in the unpurified gas. California crude oil has come under my observation containing three per cent and over of sulphur. An oil so high in sulphur will give rise to from 750 to 800 grains of hydrogen sulphide and nearly 100 grains of organic sulphur per 100 cu. ft.

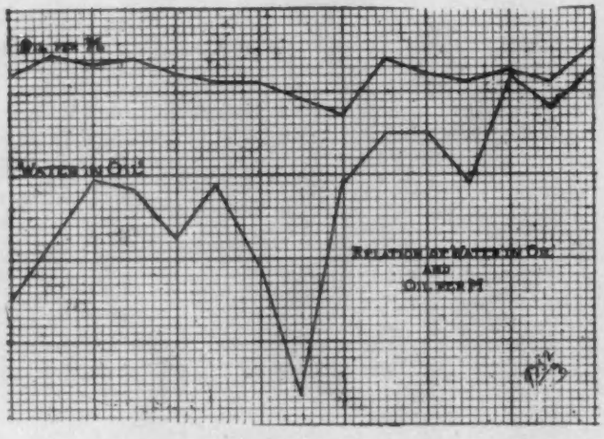
The percentage of water in crude oil is generally estimated by treating with a gasoline in a graduated cylinder and allowing the water to settle out to the bottom where the percentage is read off directly. It is usual also to include in this percentage the amount of sand or sludge which settles out at the same time. The inaccuracy of this method is so great as to make the test absolutely useless as an indication of the amount of water contained in the crude oil. The percentage shown amounts to a third or a half of the actual contents.

Most oil contracts provide for a water allowance of anything over 2 per cent. It is strongly to be urged that the distillation test be specified in all agreements for the purchase of oil, failing which gas companies are likely to be heavy losers.

The distillation method is carried out as follows.

100 c.c. of the sample are measured out in a graduated cylinder and transferred into a distillation flask, which is connected to a condenser. The thermometer may be omitted. The distillate is received into a graduated cylinder of about 15 c.c. capacity, which is drawn out at the foot so that the divisions may be more easily

read. The distillation is interrupted as soon as the water is all off, which is readily noticed by the change in the appearance of the distillation. The water and light oils coming over separate sharply in the receiver and the percentage may very readily be determined within 1/10 of a per cent. The whole operation barely requires a half hour. To avoid breakage the distillation flask may be made of metal. It is advisable in that case to heat the same with a ring burner from the sides. The distillation will then proceed quickly and without bumping.



How much the percentage of water may effect the operation results is not generally realized. Therefore, I show the accompanying diagram illustrating the same. It will be seen how many of the ups and downs in the oil per M. may be traced to the water contents of the oil.

For a study of the nature of the crude oil a complete distillation is interesting, and the residium is somewhat of an indication of the value of the oil for gas making purposes.

Next in importance to the oil is the selection of a good fire-brick which will stand the hard usage incidental to oil gas manufacture. The well known methods for the analysis of clay may be used for fire-brick analysis. The important constituents are silica, alumina and iron. Alumina and silica are of refractory nature, while iron increases the fusibility. It is possible, by analysis, to narrow the choice of a suitable brick down to a few samples, which can then be subjected to practical physical tests to determine their suitability. A trial order, for enough brick to supply one machine, will furnish means for a final valuation under operating conditions. A record maintained of such successive brickings will enable the selection of the best in the market.

The quality of the offerings is sincerely to be deplored. I had occasion, quite recently, to make analysis of some twenty samples of fire-brick from various firms in this country and abroad and regret to say, that of the lot, only half a dozen contained less than 5 per cent of iron. A prominent manufacturer has recently made the statement that he was forced to cater to the desires of his customers who refused to pay the price necessary to make a good brick. I show below a few analyses of representative fire-brick:

		% Silica	% Iron	% Alumina
1	Foreign	54.5	10.5	35.0
2	"	57.9	4.5	37.6
3	American	59.2	2.3	38.5
4	"	68.3	2.5	29.2
5	"	59.0	3.7	36.8
6	"	58.3	9.0	27.9
7	"	73.2	3.6	22.6
8	"	78.2	3.3	17.7
9	"	52.8	5.9	41.3
10	"	60.4	5.5	32.0
11	"	69.8	3.8	26.4
12	"	61.7	7.7	30.6
13	"	59.4	8.3	26.4

Lime for purifying material should be analyzed for purity and purchased on the basis of cost per barrel of pure calcium oxide. It may be found that for the manufacture of purifying materials, some of the dark colored lime containing more impurities may be cheaper for the purpose on the basis of calcium oxide content and yet satisfactory.

The same may be said of copperas.

Although an elaborate equipment is needed for the valuation of lubricating oils, yet a few simple tests in regard to viscosity may enable the selection of suitable oil for the different machinery. Should it be desired to go further into the subject, it is possible to install a home-made device for determining the coefficient of friction. It is possible, also, by temperature readings, on one particular bearing in conjunction with a record of the amount used to ascertain the practical efficiency of an oil in actual work.

Experimental Work.

Having taken all the precautions for maintenance of the quality, it now becomes the duty of the oil gas chemist to ascertain, if possible, what conditions of manufacture will produce the required quality with the least possible expenditure of oil.

The question has often arisen in my mind whether it is cheaper to enrich a very lean gas, high in hydrogen, up to the required value by means of very rich hydrocarbons, or whether it is better to maintain a rather more uniform composition. The problem is very complex and by no means depends upon the ultimate analysis of the gas, i. e. the percentage of carbon and hydrogen, but rather upon the way in which the same are combined to make up the different hydrocarbons. This results from the fact that it is quite possible to combine the same amounts by weight of carbon and hydrogen into hydrocarbons and combinations of hydrocarbons having widely different illuminating and calorific values. In other words, the several possible combinations of the same amount of carbon and hydrogen require different expenditures of energy. It follows that the combustion of these bodies will likewise liberate different amounts of energy.

Practically, of course, it is impossible in operating to produce any particular hydrocarbon to the exclusion of others. However, these various members of the same family are generally produced under much the same conditions.

We may, therefore, study operating conditions with a view to producing the maximum of that particular family which gives the highest operating efficiency.

It is well to bear in mind that while we are able to store up varying amounts of energy into the hydrocarbons, that the same must of necessity be either furnished from the energy of the oil used for heating the

sets or from the waste energy of the by-products.

Concerning the better utilization of the heating oil, the problem depends upon the following factors:

1. Quality of checkers.
2. Spacing and arrangement of checkers.
3. Investment and labor charges due to capacity of set.

Concerning the quality of fire-brick, it cannot be too much emphasized that the best is by far the cheapest from any standpoint. It is to be regretted that the best quality of fire-brick is not more generally used. A fire-brick must have sufficient conductivity and heat capacity to efficiently store up heat, and the ingredients and workmanship must enable it to stand up to the work. All generator control is absolutely useless without this prerequisite.

Assuming, therefore, that the brick are the best obtainable for oil gas, they must now be arranged in such a manner as to offer the greatest possible surface to the heat of the blast and the proper breaking up of the crude oil. This can only be obtained by complete baffling or staggering. The practice, obtaining in some localities, of laying the checkers in straight flues cannot be too strongly condemned. It is simply a confession that the amount of making oil per run has not been correctly gauged. The spacing of the checkers must be likewise set according to the quality and amount of the making oil. With heavier oils it may be necessary to carry the generator checkers much farther apart in order to prevent excessive fouling. The amount of making oil will depend upon the amount of blast pressue available for heating it and the temperature which it is desirable to carry. The more making oil used per run the wider must be the spacing of the checkers and the lower the thermal efficiency of the set. This brings us to a consideration of the investment and labor charges due to the capacity of the set. It is undeniable that in contemplating many changes that would tend toward greater operating efficiency, we are confronted with the capital investment. While very slight reductions in cost of operation will pay several times over for the increased labor and capital charges, it is doubtless true that the capital may not always be available. Changes can therefore only be made up to the excess generating capacity.

With the heating oil used to the best advantage we have a definite amount of heat stored up in the checkers, to be utilized in making the maximum amount of gas of a certain quality.

We will now discuss this point from the standpoint of the two shell machine, composed of generator or primary shell and secondary or combined carburetter and superheater. It is now desired to divide the total amount of oil between the two shells with a view to

a. Producing the most gas of the desired quality from the least amount of oil.

b. Maintain the checkers in the best shape.

It is only by diminishing the calorific value of the by-products that we can increase that of the gas produced. Now in as much as the lampblack made is fully utilized in the production of steam or in the manufacture of briquettes, we do not care, therefore, to draw upon that source; moreover, carbon tends also to increase the specific gravity of the gas and thereby to lessen the capacity of the mains. It is the carbon in combination with hydrogen, passing off as tar or pitch that we wish to retain. In so doing we would eliminate the greatest nuisance incidental to oil gas manufacture. We must therefore operate to eliminate tar and pitch. Tar and pitch are produced at the latter part of the runs, lampblack at the beginning. To eliminate the two first we must stop the run with the appearance of tar, while in order to produce the required quality of gas, we must do away with the high heats of the initial part of the run.

We thus arrive at the old water gas idea of short runs and blows, to which, of course, there is an economical limit due to the time lost during changes and purging set.

By avoiding on the one hand the high heats which tend to melt the checkers and on the other hand the low heats that cause an accumulation of carbon in the spaces, we tend to increase the life of the checker work.

By analyses and compilation of data the chemist should be able to advise changes in operating methods which should always be carried out singly in order to be sure of the cause of any observed result.

It is well for the chemist to carefully study the efficiencies and losses of different parts of the manufacture, both thermal and mechanical, as this forms the basis for all improvements. For this purpose careful measurements should be made of all materials and energy entering and leaving various portions of the works.

There is no better example of such work than that remarkable paper "The Practical Efficiency of a Water Gas Set," by W. E. McKay.

Appliance Work and Illumination Photometry.

The chemist is often the only scientific man on the manager's staff and may therefore be expected to render assistance whenever trained observation and a good knowledge of scientific principles are likely to be of use in solving any particular problem. He may be expected to gauge the capacity of appliances or regulate the burners on same or in other ways introduce scientific ideas into other departments than the works. In this connection he may be called upon to pass upon the respective merits of various brands of mantles or aid in illumination work, both of which he is qualified to handle in connection with bar photometry work.

In concluding this paper, I wish to say that I have purposely omitted many details which are readily available in the text books, and wish to especially call attention to the excellent instructions that have been brought out by the American Gas Institute for the Standardization of Photometry and Calorimetry.

A new water-power agreement has been approved by the Secretary of Agriculture. Temporary two-year permits will be issued to persons wishing to develop water-power within the national forests, thus giving opportunity to make surveys and collect data upon which the final agreement will be based. This contemplates the full development of each water-power site, with the privilege of fifty years' use.

THE PROBLEM OF TECHNICAL EDUCATION, WITH SPECIAL REFERENCE TO CONDITIONS ON THE PACIFIC COAST.[1]

BY S. B. CHARTERS, JR., AND W. A. HILLEBRAND.

Of recent years dissatisfaction has been expressed in many quarters with the results of technical, or, to be more specific, electro-technical education. However criticisms of this nature are not directed alone at the graduates and faculties in electrical engineering, but are only a part of a wider discontent with existing conditions, such as Presidents Wilson and Lowell voiced somewhat over a year ago. The chemists, for instance, are concerned with the same problem that has agitated the proceedings of our own Institute and one of the author's colleagues in the department of law expressed his opinion that one year should suffice to accomplish the work for which the average student now requires four.

Nor is dissatisfaction with the educational system of the day anything new. About two hundred and sixty years ago John Milton in a letter to Samuel Hartlib outlined a scheme of instruction and training which, between the ages of twelve and twenty-one, would give the youth of his day intimate knowledge of Greek and Latin, French, Italian, Hebrew, and the Chaldee dialect, mathematics and natural philosophy in all its branches, including both pure and applied science, the principles of economics, and, in fact everything that would constitute the vehicle of cultural training in his day or this. In addition thereto, his graduate would emerge a trained soldier, experienced in the use of his weapon, in military tactics and hygiene and was also to possess familiarity with the affairs of business and commerce acquired by actual contact with the world.

From Milton to Steinmetz is a far cry, but to the criticism of each there is a similarity in tone that is startling.

Since criticism of educational methods is neither new nor confined to one branch alone, the conclusion is inevitable that the cause does not rest solely with the college but lies deep in the organic life of our nation.

To be productive, criticism of a scheme or system must also take into account the purpose which that system is trying to accomplish, the material with which it works and the conditions under which that work is done, of which, in all that has been written of late, surprisingly little has been said. With these factors that constitute the problem of education of any kind, this paper proposes chiefly to deal.

The purpose of education is to fit the student for life, and to this end, we of the universities maintain that our best efforts are devoted. In reply we are told that instead of being fitted for his vocation, the average graduate upon entering industrial life, finds the change so great that he requires about two years in which to discipline himself to the new environment and acquire a new point of view; that college men are generally narrow, one sided, often clannish and that of the fifty per cent or less of technical graduates who eventually become engineers, but few are able to demand compensation commensurate with their services.

[1]Paper presented before San Francisco Section, A. I. E. E., Oct. 28, 1910.

Because these short comings usually accompany a university diploma the burden of them all is placed upon the college, simply because that institution had the student last, unmindful of the fact that only four of his twenty-three years were spent within its doors, and that although these years of residence have placed an indelible stamp upon him, he is much more a product of the years that went before.

The truth of these criticisms is readily admitted by university faculties, who have responded by adding from one to two years to the college course, or by instituting some form of co-operation between college and factory, such as that now established at the University of Cincinnati. The general idea back of the six-year course seems to have been voiced by President Van Hise of Wisconsin, who says that in dignity engineering will then be placed on a par with law and medicine, as if the conditions under which the lawyer, doctor and engineer each does his work were the same, so that a rule applicable to one will also fit the other. The added year or two in which a smattering of cultural training is afforded, is to greatly increase the potentialities of the present engineering graduate—but will it?

Before continuing on this topic let us turn to a consideration of the limitations inherent in formal education under present day conditions, as it exists after centuries of evolution and experience.

In school or college the student pursues at one time several different subjects, between which there is little or no correlation, to each of which he devotes a portion of his attention at different times of the day, and in which the required work demands so much of his time and effort that little is left for spontaneous or continued and concentrated thought.

Owing to the numbers of students who crowd to our engineering schools, the relative proportion of instructors to pupils has so rapidly diminished that the lecture system has largely supplanted individual instruction. A flagrant instance will be cited by way of example. One of the authors finds it difficult to teach a single class of fifteen men in a subject which he himself took at an Eastern institution where the instructor had four classes a day of from thirty to fifty men each.

Abroad this method has been developed to meet the needs of maturer and more serious students in institutions established upon fundamentally different lines, where the amount of work and attention that an individual chooses to devote is left largely to his own inclination. He may take what is offered or not, as he pleases. In America under this same system, but where the student has to satisfy a minimum requirement in order to remain in college, a considerable number who are really not fit for their profession, succeed in obtaining a degree.

The difficulty even in a small class, of learning by set and infrequent examinations what the student really knows is illustrated by the following example, which is offered because we believe it to be thoroughly typical.

Less than a year ago one of our Seniors confessed that he did not realize that when the power factor in a circuit is less than unity, for a part of the time the current is flowing in a direction opposite to that of the

source electromotive force. We had been instructing him in the principles of alternating currents for nearly a year, during which time this very point had frequently been dwelt upon. He was a man of average ability, of more than average industry, able to pass successfully his examinations, but only during an interview of three-quarters of an hour was his ignorance of so fundamental a fact discovered.

Owing to the relatively limited resources of our colleges, such instruction as brings the teacher into close and intimate contact with the student is handled for the most part by young and generally inexperienced men.

Furthermore, in spite of Mr. Taylor's objection,* the college method is inherently a sixty or seventy per cent method, making it possible for a student to oversleep or deliberately cut two or three times a semester without serious consequences. To a more rigorous discipline than that which exists in most American colleges, the spirit of this country, an illustrated in the attitude of the students, their parents and friends will not submit. College training in itself cannot give the discipline demanded by the conditions of industrial life.

In accounting for the results turned out by American colleges, no analysis is complete which does not consider the social environment of our students. Consider a group of from fifteen hundred to three thousand typical young Americans of about the same age, gathered into one community, nominally under the guidance of their teachers, but in so far as their real, spontaneous interests and activities are concerned, left entirely to their own impulses. At Stanford this condition is perhaps as acute as at any other place in the country, because the student body is so compact and far removed from any large center where the students as individuals would have other things to demand their attention and interest. In passing it may be well to remark that while the isolation of such a community is for many reasons desirable, such isolation also brings with it decided disadvantages.

A committee of Yale Alumni appointed to consider "Ways in Which the Intellectual Ambition of Undergraduates Can Be Stimulated," suggested** among other things, that it might be well to let down the entrance requirements, so that the preparatory and high school could allow the student more time in which to exercise his own tastes in the matter of study and thus cultivate an "intellectual interest in what has happened and in what is going on in the world." This suggestion overlooks one vital fact, namely that, even in the professional courses the spontaneous and vital interest of most young men and women does not lie along the lines of the curriculum, so that to compete with the otherwise all absorbing athletic and social interest we of the faculties have expanded our required work until only a minimum of time is allowed for indulgence in "outside" activities.

Also, as previously stated, little time is allowed even to those naturally so inclined for independent effort and study. In most American universities with the number of students to be handled, it is physically impossible for the faculties to give and properly supervise work of the problem nature which makes a real demand upon the intellectual powers of the student. The result is, that the principal emphasis is placed upon memory and manual labor. The wholesale problem and competition have forced standardization in education. As frequently happens, a student of inherent ability can, by putting in the time allotted for certain work, and cramming vigorously before examinations, meet the minimum requirements and obtain a degree without having received very much of what his instructors endeavored to impart.

Having considered existing conditions, the question now arises, what should the college be able to do for a man by the time he gets his diploma? What are the specification of the ideal graduate?

First, however, let us consider what the young graduate is and what opinion the world holds of him. R. T. Crane *** has expressed his views in no uncertain and complimentary terms. In an address before the Engineering Students at Stanford Mr. F. V. T. Lee said: "Don't worry about what your compensation will be after you get out. No matter what it is, you will be overpaid." The engineer of a large public service corporation remarked, "We go upon the principle that he does not know anything."

"But why do you use college graduates, rather than younger men direct from high school, or with no education at all?"

"Because they learn more readily than others," was the response.

And there you have it. Few employers want the young man except some of the large manufacturing and operating companies which have developed special organizations for continuing his education to suit their needs. The strenuous years of jumping from one subject to another have given the man who has submitted to their discipline, in addition to some knowledge of mathematics, science and engineering principles, a mental alertness and adaptability, so that he is not afraid to tackle a subject because it is new.

There he stands, a man of some knowledge, considerable adaptability, but with little real intellectual power. Is this all that the technical graduate should be?

The ideal man, to our way of thinking, upon leaving college possesses the following qualification:

1. A foundation knowledge of science, mathematics and engineering principles.

2. Ability to think in a clear and logical manner, to use the tools enumerated in number one.

3. Breadth of view toward his profession and toward his relations with society.

4. Willingness to submit to the discipline of industrial life; knowledge of what it expects of him and of what he may expect in return. He is a man who, with no loss of initiative, and while ever on the lookout for new opportunities, has the patience to abide his time and await results.

To what extent can the college contribute to the production of such a man and what portion of his training lies necessarily without the sphere of college life?

*Why Manufacturers Dislike College Graduates. Electric Journal, September, 1909.

**Report of Alumni Advisory Board to Yale Corporation, on the Stimulation of Intellectual Activity Among Undergraduates, June 20, 1910.

***Valve World, June, 1909.

This is a most vital question and must be clearly understood by both college and student if improvement over existing conditions is to be expected.

But little criticism is directed against the college man on account of what he knows, and it may be assumed that college and preparatory school are doing about as well in this regard as can be expected.

In its ability to train the student in clear and logical thinking the college is lamentably weak and the greatest improvement is to be looked for along this line, but, we thoroughly believe, only by an increased amount of individual instruction by competent and experienced teachers.

Specialized training in any field, engineering not excepted, is narrowing, and to offset this tendency, the course at some institutions has been lengthened to five and six years for the purpose of intruding so-called cultural subjects. As a result of observation and experience the authors believe that the average university with conditions as they exist today, cannot impart or even start a man on the road to culture and breadth of view unless he enters with the desire already implanted in him. Most engineering students do not care for the cultural subjects and many are in college today simply because courses are offered which do not require them. Experience throughout the country with engineers in economics, language and English courses demonstrates that ninety per cent of the men detest the subjects, do as little work in them as possible, and that the time and energy devoted to their instruction is largely wasted and for the most part fails of its purpose.

At Northwestern University, where a five-year course combining both engineering and cultural studies has recently been established, this fact is clearly recognized. The schedule is so arranged that technical and non-technical subjects run parallel throughout the five years, instead of being concentrated in the first year or two, in order that the student will not acquire the impression that history, English, economics and languages are a necessary evil but not a part of his real business. At a college in the Middle West an engineering student explained the neglect of his work in English to his professor as due to the fact that he had been devoting all of his time to his regular university work.

Furthermore, at this institution, even though it is old, as American colleges go, with a large body of alumni and the tradition of culture and humanities back of it, they expect for many years but a small registration, and are prepared to advise any student who demurs at devoting so much of his time to non-engineering subjects, to go elsewhere.

This does very well for that section of the country where so many schools are within easy reach but if Stanford were to adopt such a policy, elsewhere could only mean the University of California. Of the twenty-nine men in our entering class, all but five come from States west of the Rocky Mountains, and out of these five not one was directed to Stanford by reasons that had anything to do with the fact that he proposed to take electrical engineering. Careful inquiry among our Freshmen reveals as nearly as we can determine, that none of them came to Stanford because of the excellence, assumed or otherwise, of our department, but chiefly because the college is near enough to permit their attendance, and, of the various courses offered, Electrical Engineering made the strongest appeal.

The lengthening of our course to five or six years would probably send most of our students to the University of California, throwing an added burden upon that institution without securing the result intended.

To admit that we are turning out as engineers men lacking in breadth of view and catholic spirit, is to confess a weakness, and yet we reject the only remedy that has been offered. But is it fair to throw upon the college the entire burden of instilling the spirit of the humanities into men who will not respond to the effort that is being made in their behalf? Is nothing to be demanded of heredity, environment and previous training? Stanford offers every encouragement to the individual who, of his own volition, elects to spend five or six years in order to get the benefit of a broader training, but we are at present unwilling to prescribe such a routine for all.

The following example of the point of view of a representative group of students is offered because we believe it typical of the attitude of the undergraduates of this or, for that matter, of almost any university in the country. About a year and a half ago the authors became acquainted with a man of mature years, and wide experience, both at home and abroad, who chanced to board at a student club. But because of an odd appearance and his ignorance of who held the Coast record in the two mile or why a man runs to first base after striking a ball, he was an outcast, without friends or sympathy. His right hand neighbor, attracted by his keen intellect and original ideas, drew him into conversation, which had to be abandoned after two days because of the chorus of jeering remarks hurled from all sides. To not one of these men did it occur that he could have ideas or experienses worthy of their interest. Instead they gave full rein to hastily formed prejudice and to the natural tendencies of youth in a manner extremely disappointing to him, coming as he did from a country where university students are the leaders in thought on social, political and economic questions.

Toward a knowledge of the requirements of the industrial world and the disciplinary training which they demand, the university can contribute but little. However, so clearly is the necessity for this realized that some colleges already require of the candidate for a degree that he spend at least a part of his vacations at work in the shop or with the construction gang, under actual industrial conditions. While this is not yet among the requirements for the Stanford degree, it will be as soon as circumstances permit.

It is not to be questioned that a man's career and his conduct in life are largely determined by his point of view. Recollection of our own experience, close observation of the students who pass under us and careful inquiry among our Freshmen as to what they expect within a few years after leaving college, convinces us that the majority of men upon graduating are in their inmost souls, convinced that they are embarked upon a road which, though it has its hardships at the start, will automatically lead them to success and considerable financial return. These men see

nothing but "the top," and that at no very distant future.

To combat this attitude, without attempt to annihilate hope or ambition, is as much, and perhaps more, a part of our duty as the teaching of Ohms law.

In conclusion we make an appeal, as of the utmost importance in improving the status of our technical graduate, for a sharper realization of the limitations of university training by the student, teacher, parent and employer, in the hope that such will lead to a more intelligent effort to supplement its deficiencies and to a more intelligent and willing use of the product of the universities.

THE VOLATILE MATTER OF COAL.

The Volatile Matter of Coal is the title of the first bulletin to be issued by the new Federal Bureau of Mines. The authors, Horace C. Porter and F. K. Ovitz, conducted their investigations at the Pittsburg station while it was under the Technologic Branch of the Geological Survey.

Quoted directly, the authors say: "The investigation has already shown that the volatile content of different coals differs greatly in character. The volatile matter of the younger coals found in the West includes a large proportion of carbon dioxide, carbon monoxide, and water, and a correspondingly small proportion of hydrocarbons and tarry vapors. The older bituminous coals of the Appalachian region yield volatile matter containing large amounts of tarry vapors and hydrocarbons, difficult to burn completely without considerable excess of air and high temperature. Coal of the Western type, moreover, gives up its volatile matter more easily at moderate and low temperatures than that of the other type. The volatile matter produced at medium and low temperatures is rich in higher hydrocarbons of the methane type, such as ethane and propane, which contains a larger portion of carbon than is present in methane.

"These facts help to explain the difficulty of burning Pittsburg coal, for example, without smoke, the low efficiency usually obtained in burning high-volatile Western coals, the advantage of a pre-heated auxiliary air supply introduced over a fuel bed, and the advantage of a furnace and boiler setting adapted to the type of fuel used. They bear directly also on the question of steaming 'capacity' of coal for locomotives, the designing and operation of gas producers for high-volatile fuels, and the operation of coke ovens and gas retorts.

"The results show further that certain bituminous coals of the interior and Rocky Mountain provinces give promise of good yields of by-products of coking, notably ammonia and high candle power gas, comparing favorably in these respects with the high-grade coking coals of the eastern province.

"They show also that inert, non-combustible material is present in the volatile products of different kinds of coal to an extent ranging from 1 to 15 per cent of the coal."

The bulletin will be of interest to fuel engineers, designers and builders of gas producers, gas and coke manufacturers, superintendents of power plants, railway master mechanics and those engaged in the suppression of smoke. The bulletin may be obtained by applying to the Director of the Bureau of Mines,

FAKE ENGINEERING SCHOOLS.

BY ANTONE'S BROTHER.

Brother Antone having been so successful in the electrical engineering line, I concluded to try the business myself, Brother Antone being the guiding spirit, in piloting me to an institution where the mysterious and elusive knowledge was to be obtained.

His own experience with graduates of some of the universities had not been excessively flattering, and he suggested we look up some of the private institutions, obtaining a bunch of catalogues from some of the so-called engineering schools. We started on No. 1, a catalogue of eighty pages, telling in glowing terms of the grand openings for engineers, with a liberal number of pages devoted to the names and addresses of successful students, none of whom to date have answered our inquiries, and we presume they are too busy with their onerous duties in their responsible positions to trouble answering our letters.

After a careful perusal of the catalogue, which was a creditable example of the lithographer's art and would lead you to suppose that it illustrated something, we concluded to visit the establishment, and upon entering the office we were greeted by a very affable young lady, who, upon being informed of our mission, handed out one of the catalogues and advised us that she would ask the professor of electrical engineering to come down and talk with us. Upon greeting us and stating that they taught a complete course in both theory and practice, we were advised that he was the instructor and as it later developed the only instructor. We asked to be shown the electrical department, whereupon he kindly conducted us to the rear of the main building into a little board on end shack which would probably answer for the purpose of a wood shed if the owner limited his fuel supply to a ¼ cord.

Now this department was especially designed for electrical teaching, being fitted up with 5 bell push buttons, and two dry cells connected so as to be operated either in series or parallel, also one ½-kw., d.c. dynamo made in 1870, but needing a little repairs. The dynamo was supposed to be driven by an old gasoline engine, carefully shined up but not in order. A little old dinky switchboard was stuck up on the wall and the instructor informed us that the floor was especially made for tracing the leads from the dynamo as the boards were loose and could be taken up to trace the complicated leads of three wires, which he required each student to take up and place in position before he was permitted to graduate.

Having looked the laboratory over which could be duplicated at any second hand store for $50 at the most, Antone began to ask the professor some practical questions and after the third question, which any ordinary wireman would have to know, he got down off the perch and made a clean breast of his sins and vicissitudes.

The policy of this institution is invariably cash in advance and no money returned under any conditions, or transfer of scholarships. Hundreds of farmers' boys are coming to this institution which advertises far and wide. If you are sending your boy to a school see that they are at least prepared with competent teachers and equipment to teach him what you are paying for.

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POWER AND GAS

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NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office *ten days in advance of date of issue.* New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
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FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

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Education

The college may well be regarded as a mint which puts its stamp upon the graduate before he enters business life. Just as the gold, silver, nickel and copper from which our money is made must be submitted to many processes in mine, mill and smelter before it is fit for the coiner's hands, so must our youth be prepared through early life for a college training. There are many graduates who, like silver, nickel and copper coins, circulate at far more than their intrinsic worth because of the advantage gained by a college education, while there are some men of pure gold that do not need such a distinguishing mark. There are counterfeits and imperfect coins as well as many foreign ones circulating in the wrong place and consequently not accepted at their face value.

Iron, lead and zinc are far more valuable for industrial purposes than for coinage, just as many men are not fitted for a college education. We could better dispense with copper coins than with copper conductors, and likewise there are some mediocre college graduates who would be more successful if they had learned a trade. All of which goes to show that it is the material in the man and not his education which makes him successful. After it has left the mint, only a numismatist is interested in a coin's antecedents. Commercially it matters little where a man graduated, or when, he is merely expected to make good in whatever he undertakes.

Parents usually consider that the major part of their filial responsibility has been discharged when their children have been given an education. Note the complete passiveness of the subject in the last clause, who does not seek the education but is given it. Herein lies the reason for nine-tenths of the educational failures, and likewise, in its converse, for most of the educational successes. Children go to school to be taught, students should go to college to learn. Then and then only can the college, as the active agent, or predicate if you please, accomplish the desired object of fitting the student for life.

The problem of technical education is now receiving much attention. The ideas of the instructor are well expressed in the paper by Professors Charters and Hillebrand of Stanford University, as published elsewhere in these columns, by which it may be seen that the problem of the educator would be greatly simplified if there was some automatic means of presenting for college training only the right sort of material, properly enthused with sincere desire for knowledge. There is undoubtedly much room for improvement in teaching methods but there is greater need for serious thought among those that are to profit from the teaching. It matters little whether the course is four or six years in length, as the man really begins to learn the true lessons of life after he has left the college. If he be of the right sort he will stop learning only when he ceases work.

PERSONALS.

A. M. Hunt left last Monday for Portland on a ten days' business trip.

R. D. Holabird, president of the Holabird Reynolds Company, is at Seattle.

K. G. Dunn, with Hunt, Mirk & Co., left last Wednesday for Portland and the Pacific Northwest.

G. F. Kirkpatrick, of the General Electric Company's lamp department, has gone to the Los Angeles office.

L. R. Wiley, who is interested in an electric power project at Groveland, Cal., was a San Francisco visitor last week.

Russell Wolden, is now at San Jose looking after the branch store of the California Electrical Construction Company.

S. K. Colby and F. A. Richards of Pierson, Roeding & Co. have returned to San Francisco from an extensive Eastern trip.

C. F. Flinn, of the sales corps of the Allis-Chalmers Company, has returned to the San Francisco office after a trip to Eureka.

Nathaniel A. Carle, consulting engineer, Seattle, Wash., has been transferred to the grade of Member in the American Institute of Electrical Engineers.

James F. Kinder, assistant secretary of the Duplex Metals Company of New York, is at Portland, Ore., where he plans to make his home and to open a branch office for the company.

H. E. Boyrie, formerly Seattle manager for C. C. Moore & Co., and later with the Hallidie Machinery Company, is now sales manager of the Tracy Engineering Company of San Francisco.

W. A. Schoel, formerly with the Portland Railway, Light & Power Company, recently took charge of the steam plant and line department of the Northwestern Corporation at Dallas, Oregon.

John B. Ingersoll, chief electrical engineer of the Spokane and Inland Empire Railroad Company of Spokane, Wash., has been transferred to the grade of Member in the American Institute of Electrical Engineer.

H. C. Goldrick, manager of the Kellogg Switchboard & Supply Company's Pacific Coast branch, recently returned from a Southern California tour. He reports some good inquiries from various points on the Coast.

F. B. Gleason, manager of the San Francisco branch of the Western Electric Company, is visiting the company's offices at Chicago and New York. W. F. Berry, local sales manager for the company, is at the Hawthorn factory.

Cyrus Pierce, San Francisco representative of N. W. Halsey & Co., has returned from New York where he completed arrangements for taking up the $1,500,000 refunding bond issue of the San Joaquin Light & Power Company.

H. J. Tinkham, formerly connected with the plant department of the Pacific Telephone & Telegraph Company at San Francisco, has gone to Spokane, Wash., where he is now superintendent of plant for the Spokane District, vice T. H. Elsom, resigned.

A party of Pacific Telephone & Telegraph officials have returned to San Francisco from Seattle, where they spent a week before the inquisitors of the Railroad Commission of the State of Washington, which has jurisdiction over telephone companies as well as railways. Among the party were P. H. Coolidge, assistant general manager; F. C. Phelps, auditor; C. B. Bush, general commercial superintendent; C. W. Burkett, general superintendent of plant, and B. C. Carroll, general agent.

C. E. Groesbeck, Pacific Coast manager, and F. E. Osthoff, second vice-president of H. M. Byllesby & Co. of Chicago, went to Eureka last week with a party of capitalists. It is understood that negotiations are on foot for acquiring the Humboldt Light & Power Company's system.

E. V. D. Johnson, manager of the Northern California Power Company, had a narrow escape from death in a collision of his automobile with the Shasta Limited near Redding, California, on November 7. The automobile was wrecked and Mr. Johnson was severely though not dangerously injured, his shoulder being broken.

TRADE NOTES.

Chicago Fuse, Wire & Manufacturing Company announces that they are now located permanently in their new six-story building 1014-1022 West Congress St., Chicago, Ill.

The Standard Electric Time Company of Waterbury, Connecticut, with Pacific Coast offices in the Foxcroft Building, San Francisco, have recently equipped five government buildings with their service, including a 200-clock installation at Tacoma.

The United Telephone Company of Woodburn, Ore., has placed an order with the Kellogg Switchboard & Supply Company for a complete central office with a common battery harmonic equipment. This includes a General Electric arc rectifier, harmonic pole-chargers and a wire chief's desk.

T. E. Trask, consulting engineer, Los Angeles, has completed plans and specifications for a municipal water pumping plant for Imperial, California. Mr. Trask recently let a contract for a pumping plant and piping system for irrigating a tract at Orange Cove, Cal. The contract calls for a De la Vergne crude oil engine.

The Westinghouse Electric & Manufacturing Company has sold to the Sacramento Valley Irrigation Company electric motors aggregating 1050 h.p., in three vertical units. Each of the three 350 h.p. 2000 volt induction motors will be direct connected to a turbine pump of special design. The pumps, which will be constructed locally, are to be installed at "the Headgates," near Hamilton, where electrically driven pumps with a capacity of 500 h.p. are already in operation. The new equipment is to be used in connection with the Kuhn projects on one of the largest irrigation and reclamation enterprises in California.

NEW CATALOGUES.

Electric Lighting for Motor Cars and Marine Service is the title of a pamphlet from The Electric Storage Battery Co., portraying their "Hyray" electric lamp.

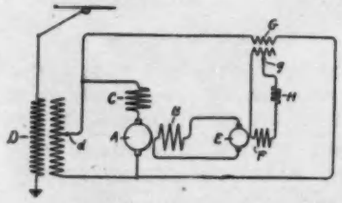
Westinghouse Auxiliary Contactor Equipments are briefly described in Folder 4186 just issued by the Westinghouse Electric & Manufacturing Company.

Bulletin No. 4771, entitled "Hand-Operated Starting Compensators for Alternating Current Motors," has recently been issued by the General Electric Company. superseding previous bulletins on this subject.

Duncan Electric & Manufacturing Company have just issued a new bulletin, No. 11, on Duncan Transformers for Lighting and Power. After briefly sketching the historical development of the transformer it gives illustrated details of the design and construction of Duncan transformers, including the core, coils and insulation, which are followed by an account of the electrical performance. Types listed include those adapted for lighting circuits, power service, subway use, transmission lines, potential or current transformers, tungsten sign lamps, welding and compensators. The section devoted to testing gives valuable instructions and diagrams for the most important transformer tests. The concluding pages are devoted to directions and diagrams for connecting.

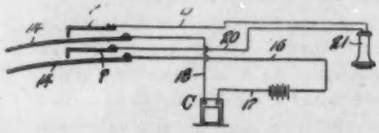
PATENTS

974,224. Electric Braking. Ernst F. W. Alexanderson, Schenectady, N. Y., assignor to General Electric Company. The method of operating an alternating current commutator motor as a generator returning energy to the source for dynamic braking, which consists in connecting the motor armature to the source, separately exciting the motor field



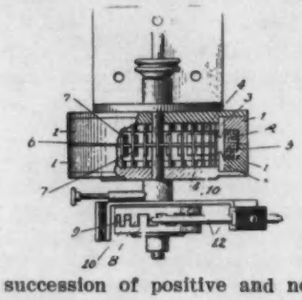
with current approximately in phase with the voltage of the source, varying simultaneously the connections between the motor armature and the source and the strength of the current supplied to the motor field to vary the braking torque, and varying the strength of said current independently to adjust the motor voltage for different speeds.

974,712. Armature-Testing Device. Levon H. Seyranian, Monterey, Cal. An armature-testing device comprising a handle composed of sections, said handle having channels, lead-in wires disposed in the channels, fixed contacts connected with certain of the wires, and spring contacts con-



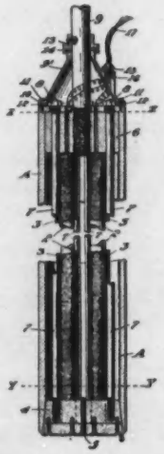
nected with the other wires, said spring contacts being normally separated from and disposed opposite from the fixed contacts respectively and projecting beyond the same to be brought into contact with a pair of commutator bars for testing the windings of an armature.

974,171. Rectifying Electric Currents. John J. Montgomery, Santa Clara, Cal. In the art of reorganizing alternating electric current the herein described process of rectification which consists in the following operations: (1) In imparting to the moving element through the agency of a fixed element and the utilization of a derived portion of the current under



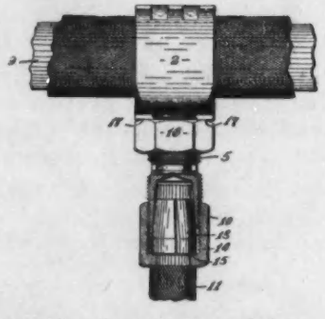
rectification, a succession of positive and negative accelerations, the resultant effect of which is a step-by-step progression of the moving element undulatory in its character, the successive undulations being in response to the successive variations of the electrical forces of the current under rectification, and in synchronism with and coterminous as regards time with, such variations, whether such variations occur in successively equal times or not; and (2) in imparting the said step-by-step progression to an element of a pole changing device having its other elements connected to the circuit carrying the current under rectification, and which said element receiving said step-by-step motion co-operates with the other elements of the pole changing device to successively reverse the order of the terminal connections of the circuit carrying the current under rectification to a utilization circuit.

974,760. Electric Fishing-Tool. Harry Eastwood, Fresno, Cal. An electrical fishing-tool comprising a non-magnetic water-tight casing having at its lower end a removable, tapered armature forming a closure, and electro-magnetic means



housed in the casing and connected with said armature, said armature made in sections insulated from each other and adapted to be separately energized.

974,462. Electrical Coupling. Carl H. Bissell, Syracuse, N. Y., assignor to Crouse-Hinds Company, Syracuse, N. Y. In an electrical coupling, a band member comprising two sections pivotally connected to each other at corresponding ends and provided at their opposite ends with opposing externally threaded projections, a main member having a shank pro-



vided with an engaging face at one end for co-operating with the band member, the shank having a substantially cylindrical portion, and the inner faces of said projections being shaped to conform to the periphery of the cylindrical portion of the shank, and a nut for engaging the externally threaded projections and the shank, substantially as and for the purpose described.

INDUSTRIAL

A NEW ELECTRIC RANGE.

The kitchen equipped with electric heating devices is a "model kitchen," free from smoke, ashes, gas odors, fire hazard from naked flames, prostrating heat in summer time, delays waiting for the kindled fire to burn, nuisance of matches, etc. The bustling housewife of the present day gladly adopts devices which add to her convenience or enable her to prepare food in a more sanitary manner. Electric heating devices mark a great stride forward in both respects and are being widely adopted.

The domestic electric range recently perfected by the General Electric Company is a decided advance in the right direction. It is patterned after the ordinary gas range and cooking can be done with it as quickly as with gas or coal, due to the fact that the heating elements are made of calorite, a wonderful new alloy discovered by the same manufacturer after years of scientific investigation in its extensive research laboratories.

There are three disk stoves on the top of the range designed to be used in the same manner as the burners of a gas range. A turn of the snap switch turns on the heat instantly at full intensity, while another turn cuts it off, and so permits the elimination of any expense for current when the stove is not actually in use, without incurring a delay in getting it into operation again. The two larger stoves are provided with a switch which admits of a three-heat regulation, thus making it possible to get a low, moderate or high heat, as conditions may require. The three stoves permit cooking one, two or three things at once.

The combination oven and broiler is commodious, being 18 inches by 18 inches by 12 inches, and ample for the needs of a large family, and is provided with heating units at both top and bottom. By removing the ceiling plate of the oven, the top heating element of the latter is exposed and may be used as an overhead radiant broiler, or for the purpose of producing a pronounced browning of pies, biscuits, roasts, etc. The ceiling plate can be used as a shelf to support the broiling pan at the proper distance below the heating element.

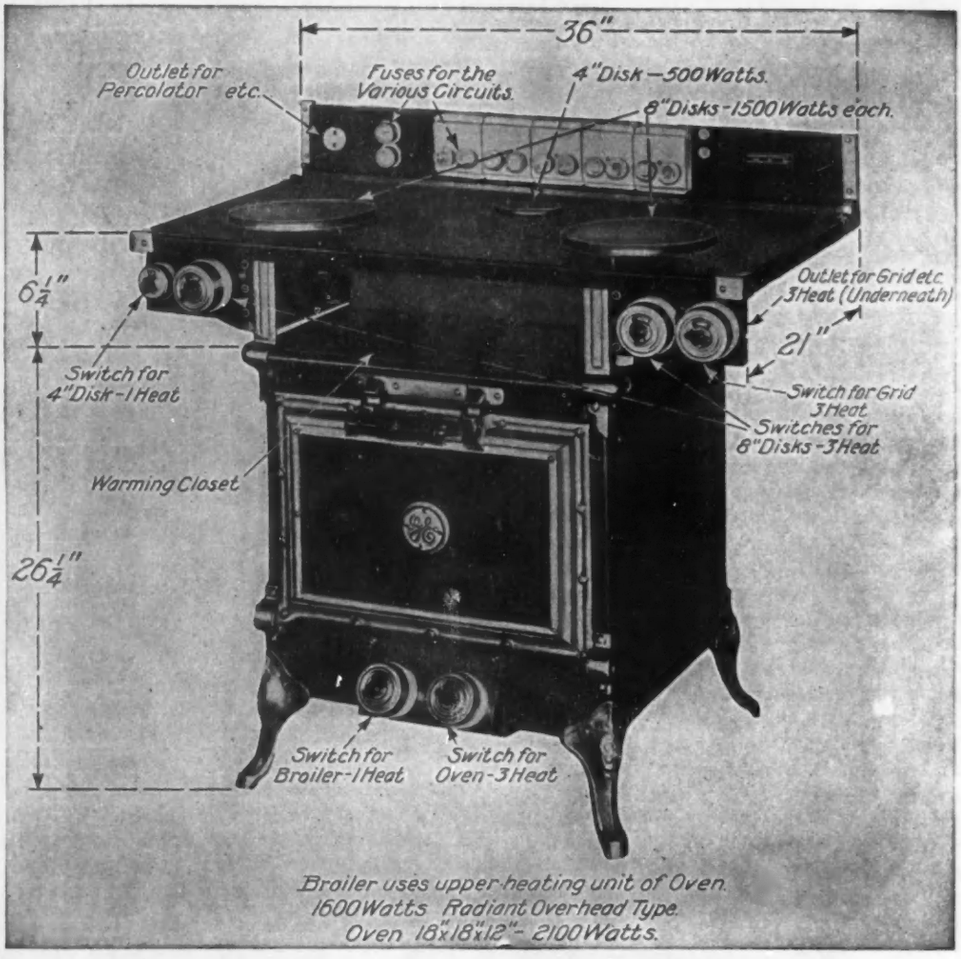


Fig. 1. General Electric Company's New Domestic Range, Type D-22, Showing Dimensions.

The slide supports on the side of the oven permit vertical adjustment of the broiling pan and oven shelves, and also the use of several shelves at once. The broiling pan (which is furnished with the range) is also suitable for use as a roasting pan. Printed instructions accompany each range, and tell what "heat" to use and how long to leave it on to bake or roast the various kinds of meat, bread, cake, pie, etc. The stoves, broiler and oven all have independent controlling switches. It is not necessary to use a thermometer with this oven, as the temperature attained at the various positions of the switch for the intervals of time stated in the instructions accompanying the range, will be best suited for each individual case.

The space between the stove top and the oven is heated

indirectly from the oven, broiler and stoves, and so makes a convenient plate and food-warming closet.

To increase the usefulness of the range two additional outlets are provided for individual electrically heated devices; one being an outlet for a percolator, etc., of one heat and not over 600 watts, the other an outlet for a grid or other three-heat electric device, a three-heat switch being mounted on the range for its control.

The equipment of the range is as follows:

2 8-inch disc stoves, 375-1500 watts; 3-heat switch.
1 4-inch disc stove, 500 watts, 1-heat switch.
1 broiler, 1600 watts; 1-heat switch.
1 oven, 575-1150-2100 watts; 3-heat switch.
1 warming closet (directly heated).

The circuits to each part of the range are separately fused by a double-pole fuse block, while a main fuse of 60 amp. capacity protects the entire range. The wiring is arranged for either two or three wire connection.

The range is of sheet metal construction throughout, made in a workmanlike manner and finished with nickel trimmings. The oven door is of the spring drop style and is provided with a substantial and effective latch.

FLAMING ARC LAMPS FOR LIGHTING LARGE AREAS.

The development of the flaming arc lamp and its general commercial application to lighting large areas has brought about an important advance in the efficient lighting of machine shops, railroad yards, foundries, warehouses, wharves and convention halls. This form of lamp owes its popularity for this class of service to its great brilliancy, its penetrating power, its low operating expense and its pleasing effect upon the eyes.

It used to be the common practice to hang up almost any kind of a lamp in a haphazard way to light a mill, but those days of inefficient lighting are past, and to-day the mill superintendent recognizes the fact that a well-lighted shop means more and better work and contented workmen.

In foundries, steel mills and machine shops where the ceilings are high, lamps of great penetrating power must be used, because at the present time traveling cranes are used in almost every shop of any size, and in many cases it becomes necessary to hang the lamps above these cranes.

The large machine shops and foundries are generally built with two or three bays, a popular arrangement being one central bay, in which the heavy work is handled, and one or more side bays usually built with galleries in which the lighter and detail work is carried on. Often these side bays also have traveling cranes, and in that case the lamps are hung around the sides of the bay. The upper gallery and main bay, however, are generally illuminated by hanging flaming arc lamps above the cranes. Before the introduction of the flaming are lamp no solution could be found for successfully lighting these high-ceilinged interiors where dust, smoke and vapor were always present, but in the flaming arc we find a lamp suitable for such service.

For some time the Crucible Steel Company of America, at Harrison, N. J., had difficulty in finding a satisfactory means of illuminating its gun and projectile shop. In this shop, which works day and night, turning out guns and projectiles for the United States Government, good light is imperative. The guns and projectiles made for the Government are built under very rigid specifications, and each shell and gun undergoes very close inspection during the process of construction. It is apparent that without good light much of the work would fail to pass the inspection and thus be rejected.

This shop was formerly lighted by carbon arcs, but these proved unsatisfactory, and incandescent lamps were added. These individual incandescent lamps were hung near the various lathes, planers and other machines, and it was thought that this would solve their lighting problem. This combination failed, however, for the men on the night shift were continually having trouble with their eyes. As a last resort, flaming arcs were tried, and after a thorough test seven Western Electric "Hawthorn" flaming arcs were installed in the main gun shop and three in the adjoining shop. These lamps were run two in series on a 110-volt circuit, and although the voltage is very unsteady, due to the fact that two or three 40 or 50 horsepower induction motors are often started or reversed simultaneously, the lamps are operating very satisfactorily.

It is interesting to note the increased production resulting from the installation of these lamps. After the flaming arc lamps had been installed for some time it was noted that the increase in the amount of work turned out by the night shift was a little over 10 per cent. In order to determine whether or not this was due wholly to the introduction of the flaming arcs, the lamps were taken out for a time and the night work carried on with the old lighting system. It was then found that the amount of work dropped off over 10 per cent, and that when the work was again carried on under the flaming arc lamps the men were able to produce 10 per cent more work.

Hawthorn Flaming Arc Lamps at the Gun Shop at the Crucible Steel Company of America's Harrison, N. J., Plant.

This increase in production is due not only to the amount of light, but to the quality. The golden yellow rays of the flaming arc lamp are stimulating in character and very easy on the eyes, and since these lamps have been installed night men have found it possible to turn out a greater amount of work with less effort than was possible with the old carbon lamps.

There is no doubt that the illuminating engineer has an instrument in the "Hawthorn" flaming arc lamp which will greatly assist him in giving his client a satisfactory means of lighting large areas.

The problem of lighting foundries has heretofore been a difficult one because of structural conditions, overhead cranes and the presence of smoke and dust. One or two flaming arcs hung above the cranes will satisfactorily light a foundry 50 by 100 feet.

As to the economy of such an installation, the flaming arc stands out prominently as the cheapest illuminant, when we consider that a flaming arc lamp gives 3000 candlepower at 550 watts, the operating cost is low, and so few units are required that the installation and maintenance cost is very small.

NEWS NOTES

FINANCIAL.

ONTARIO, CAL.—The water bonds election was voted here on October 31st; bonds amounting to $175,000.

OCEANSIDE, CAL.—Sealed bids will be received by the Board of Trustees of the city until 4 p. m. November 23 for the purchase of $20,000 water works bonds.

ASHLAND, ORE.—Bonds for the completion of the electric lighting and power system have been sold to J. N. Wright & Co. of Denver, and the plant will be rushed to completion.

PASCO, WASH.—The proposition of issuing $39,000 for the purchase by the city of water works, plant, system, right-of-way land lots and the franchise now operated by the Pacific Light & Power Co. Election to be held December 6th.

LOS ANGELES, CAL.—In order that work on the aqueduct may be accelerated and no time lost for want of funds, negotiations have been entered into between the city officials and a New York bond syndicate which may result in the syndicate's purchasing $1,000,000 of aqueduct bonds at once and in advance of its February option.

SACRAMENTO, CAL.—A special municipal election will be held in the city of Sacramento, Cal., on November 16th, 1910, at which time will be submitted the question of issuing and selling bonds in the amount of $666,000 for the purpose of acquiring and constructing a filtration plant, reservoirs, pumps and other appliances to be used with and in connection with its waterworks for the purpose of storing filtering, purifying, conducting and distributing water for the use of the city.

TRANSMISSION.

CHEHALIS, WASH.—This place has decided to install all wires and pipes for lighting and heating purposes underground in the future.

GUIER, WASH.—D. E. Witt of the Trout Lake Valley is preparing for the installation of an electric plant to light and operate machinery on his ranch.

HILLSBORO, ORE.—The county court has granted the franchise of the Independent Electric Company to set poles on the county road from Oak Park to Beaverton.

SPOKANE, WASH.—This city has started negotiations to obtain control of all the power sites on Priest river from its source in Priest lake to its conjunction with the Pend d'Oreille river.

ALAMOGORDO, N. M.—Preliminary construction work for the hydro-electric power plant in Box canyon is now under way, with T. M. Morton in charge. M. H. Fisher is also interested in the project.

ELTOPIA, WASH.—This place will be soon supplied with electricity. The Yakima Light & Power Company contemplates running a high voltage wire from Pasco to Lind, Wash., serving intermediate points.

LEWISTON, IDAHO.—Steps have been taken by the Lewiston-Clarkston Improvement Company, of which E. H. Libby is president, for the enlargement of the steam auxiliary power plant located on the Snake river.

OROVILLE, CAL.—O. M. Enslow, a Berkeley engineer, has filed upon 40,000 miner's inches of water in French Creek. The appropriation states that the water is to be used for the purposes of power manufacturing. A dam 100 feet high and 600 feet long at its crest is to be built and the water carried by flume to the proposed plant.

CENTRALIA WASH.—Bids will be received up to November 15 by the city clerk for delivering machinery for a 1000 kilowatt turbo-generator lighting plant, said machinery to be delivered f. o. b. this place. Specifications at the office of city electrician, C. A. Harmony.

SAN FRANCISCO, CAL.—City Attorney Long has informed the Supervisors that no corporation has a legal right to install steam pipes in public streets, for the purpose of furnishing heat to consumers, without first having obtained a franchise from the Supervisors.

TACOMA, WASH.—The Seattle-Tacoma Power Company through Attorney N. W. Brockett, representing Manager Morton Ramsdell, petitioned the Board of County Commissioners for a franchise to set its poles on the Indian Ferry-Stuck Valley road. The hearing of the application for the franchise has been fixed for November 25.

CHICO, CAL.—Charles Leege of San Francisco, president of the Central Traction Co.; T. Tognazzini, vice-president of the Swiss-American Bank of San Francisco and of the traction company, and A. B. Parker, a San Francisco capitalist, have been here to inspect the plant of the Sacramento Valley Power Company in which they are interested. Plans for the enlargement and extension of the plant are being considered.

ANDERSON, CAL.—Five carloads of machinery consigned to the Northern California Power Company have arrived here. All this will be hauled by traction engines to the company's new power house under construction at Coleman, on Battle Creek, five miles upstream from Ball's Ferry. Ten miles of ditch are under construction. One mile of siphon pipe will be laid. The pipe will be seven feet in diameter. The total generating capacity of the Coleman plant, which will be in operation by June 1 next year, will be 16,000 h.p., making the total output of the power company 47,000 h.p. The company has 258 miles of 22,000 volt lines and 126 miles of 66,000 volt lines. There are 34 sub-stations located at these places: Redding, Iron Mountain, Horsetown, Germantown, Keswick, Kennett, Copper City, Winthrop, Gladstone Mine, Brunswick Mine, Millville Magalia Mine, Lappin Mine, Balaklala Mine, Mammoth Mine, Manton, Shasta, Old Diggings, Coram, Baid, Proberta, Heroult, Anderson, Cottonwood, Red Bluff, Tehama, Los Molinos, Vina, Chico, Orland, Corning, Willow and Hamilton.

TRANSPORTATION.

MISSOULA, MONT.—The local electric railway will start in the spring on the extension of the line.

MEADERVILLE, MONT.—Mr. Wharton, manager of the electric street railway here, states that the line will be extended about half a mile.

TUCSON, ARIZ.—Within a few weeks a street car line, costing approximately $12,000, will be built out east on speedway by the Tucson Electric Railway Company.

LEWISTON, IDAHO.—H. Galvani, engineer in charge of right-of-way for the Pacific Power & Light Company, and the Walla Walla Valley Railway Company is here on business connected with the establishment of the proposed Lewiston to Asotin interurban railway.

SACRAMENTO, CAL.—Ballasting has been completed on this company's line to Stockton. This has permitted the company to cut down the running time between Sacramento and her sister city in San Joaquin 20 minutes. Beginning November 1 six trains a day will be run. They will leave Eighth

and J streets as follows: 7:10 a. m., 10 a. m., 12 m., 2:10 p. m., 4:30 and 6:50 p. m.

OAKLAND, CAL.—The Peninsular Railroad Company has begun work on the line, which is to connect Alameda mole with the Sixteenth street station. Franklin street north of Fourteenth is being plowed up in preparation for the laying of tracks to Twentieth street. It is the intention of the company to electricize its present line to the Alameda mole, which is known as the narrow-gauge. It extends from the mole to Fourteenth and Franklin streets. It is from the station at this point that the tracks are to be extended. The company will form a loop track between its Alameda and Oakland moles, a condition which will greatly improve all local traffic.

SAN FRANCISCO, CAL.—A second petition for a receiver and an accounting of the affairs of the San Francisco, Vallejo and Napa Railroad Company has been filed in the U. S. Circuit Court by Arthur W. Fox of Harrogate, England. It is alleged that W. E. Botsford, the president, and J. T. York, vice-president and secretary of the railroad company, have appropriated the proceeds of the sale of the company's bonds to the extent of $968,000. The allegation is made that the defendant is insolvent and that it is necessary that the road be kept in operation to prevent loss, for which a receiver is asked. The complainant holds 952 shares of $100 each and bonds of the par value of $176,000.

ILLUMINATION.

HERMISTON, ORE.—The City Council has granted to B. A. and G. A. Chisholm a franchise to put in an electric plant at this place, to be installed within the next six months.

CLARKSTON, WASH.—The Lewiston-Clarkston Improvement Company has completed plans for the improvement of the lighting and power system, representing an expenditure of $100,000.

CENTRALIA, WASH.—The Council has adopted the plans and specifications of City Electrician Harmony for the installation of a complete lighting plant, the estimated cost of which is between $40,000 and $45,000.

LEWISTON, IDAHO.—Ray M. Hart of this city and other capitalists have formed a company for the manufacture of gas in this city. Its franchise specifies that the construction of the plant must be begun within two years of its acceptance by the city.

LONG BEACH, CAL.—On Tuesday the Long Beach Consolidated Gas Company will take charge of the holdings of the Inner Harbor and Edison Gas Companies and abandon the gas plant on Alamitos avenue. The pumping plant will be maintained there for customers in the eastern part of the town until the installation of a new 500,000 cubic feet gas holder which is to be built on inner harbor. The company will also build a 16-inch main from the new plant to Pine ave.

FRESNO, CAL.—General Manager A. G. Wishon says: "Within the next three weeks it is hoped that the power line of the San Joaquin Light & Power Company may be extended from the big power house to the Kings River rock crushing plant, where the Sharp Fellows Company is constructing one of the largest rock crushing plants in the State, at the end of the Santa Fe extension line now under way. The rock crushing plant will supply the rock to be used in the Santa Fe road bed and for other commercial purposes. It also is believed that well within six months the power line from the Crane Valley plant will have been completed into Bakersfield.

PORTLAND, ORE.—General Manager H. M. Pabst of the Portland Gas & Coke Company announced last week that $500,000 would be expended next year extending gas mains to the suburban residence sections of Portland. Mr. Pabst is now at work on his estimates for 1911 and says that, as at present outlined they contain proposals for the largest amount of work the gas company has ever done in Portland in any one year. The purpose of the company is to supply the entire East Side from the southern extremity of Sellwood to St. Johns, and extending as far east as Rose City Park and Montavilla with all of the intervening territory. On the west side the company expects to furnish gas to the residents to the south as far as Fulton and to much of the newly built up sections in the western portions of the city including the finely populated district beyond Portland Heights extending to Council Crest.

WATERWORKS.

CRESSWELL, ORE.—R. H. Parsons & Co. have secured a lot near the planing mill on which they will erect a tower, and tank to be used by the city water system. The water mains will be extended to the Stratford and Willour Additions at once.

SAN JACINTO, CAL.—Williams & Coffen of Los Angeles, principal owners of the Citizens Water Company which has recently taken over the property of the San Jacinto Valley Water Company, were here last week. The company plans to greatly enlarge and improve the system.

OAKLAND, CAL.—In the annual report of the Peoples Water Company the following is said of the company's new distributing reservoir, located in the hills back of East Oakland: "The central reservoir has just been completed at a total cost exceeding $325,000 (every portion of which is solidly cemented with expansion joints at 12-foot intervals and inclosed by a substantial cement wall three feet in height). It covers 14 acres, has no drainage area and is free from any possibility of surface or underground contamination. Its capacity is 150,000,000 gallons, furnishing an independent gravity reserve supply sufficient for Oakland and Alameda for ten days. Its elevation is 198 feet at the bottom of the wall. The maximum output from artesian sources can now be maintained uniformily through the entire 24 hours.

TELEPHONE AND TELEGRAPH.

VANCOUVER, B. C.—Mr. Geo. B. Halse, manager of the British Columbia Telephone Company, has announced that that company will next spring lay a Pupin coil submarine cable to connect this place with Victoria.

ABERDEEN, WASH.—Negotiations have been about completed for the construction of a telephone line to connect Aberdeen with Westport. This is being backed by local shipping people, and if completed will enable them to have direct communication with the United States life-saving station at the entrance of the harbor and by this means keep in touch with the arrivals and departures.

LOS ANGELES, CAL.—The installation of an efficient and economical fire alarm system and police signal system in the City of Los Angeles, not only to cover its present but its future needs, has been found desirable, and therefore it has been decided to place the complete investigation of this matter in the hands of expert engineers, who will make a complete investigation of the present system, as well as the present requirements, lay out a complete and final plan which may be installed in parts as desired and required by the growth of the city for an ultimate fire alarm system and police signal system, which will fulfill all requirements for not less than twenty years in the future. The members of the committee which has been appointed by Mayor Alexander and approved by the City Council on October 20th are C. L. Cory of San Francisco, E. F. Scattergood of Los Angeles, and Theo. B Comstock of Los Angeles. They will investigate all of the fire alarm systems at present in use to the end that most satisfactory plans may be made for the use of and followed by the City of Los Angeles.